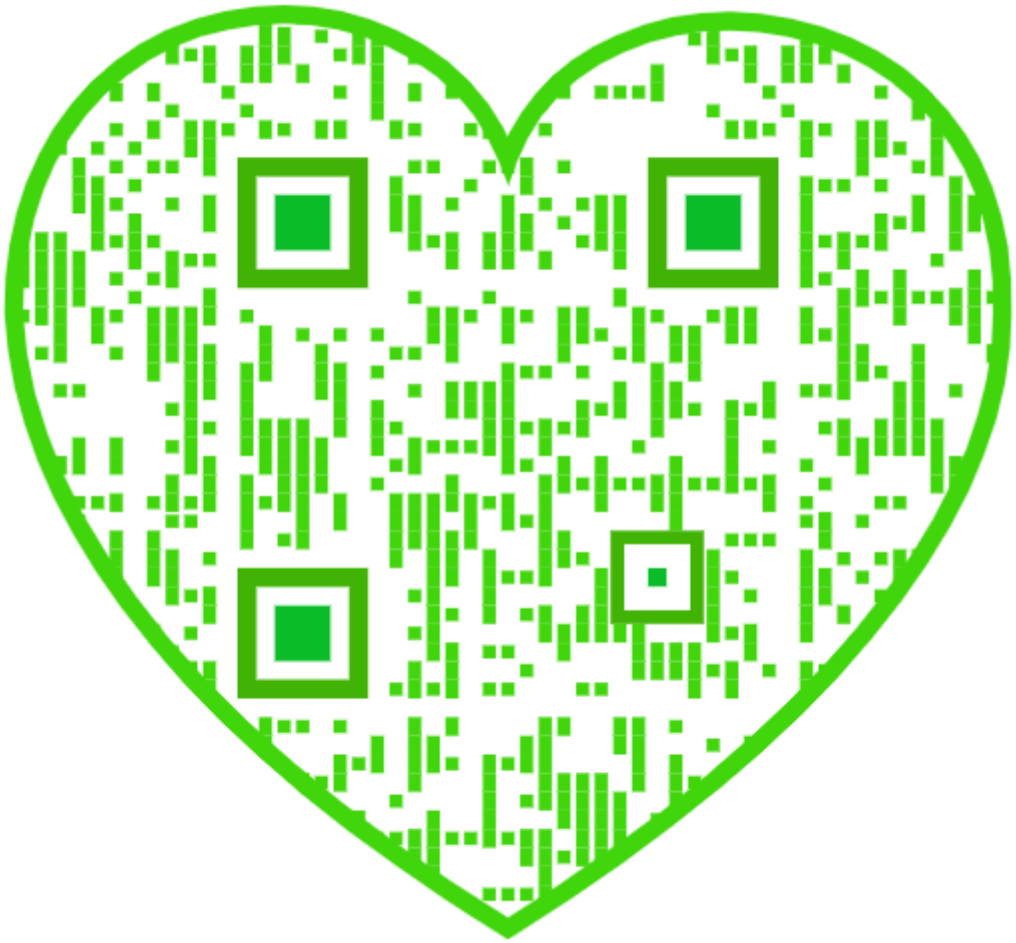
Mr A. T. Kidder
Compliments of W.E. Porter

THE MANUFACTURE DYEING PRINTING AND FINISHING OF TEXTILES

TS1446
P2



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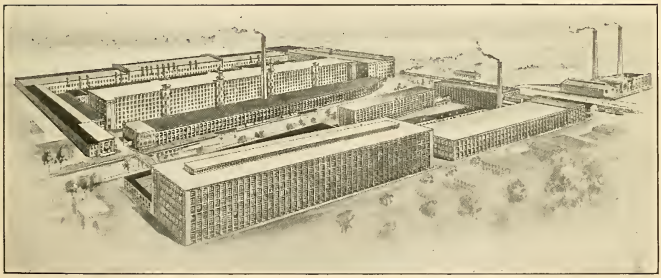
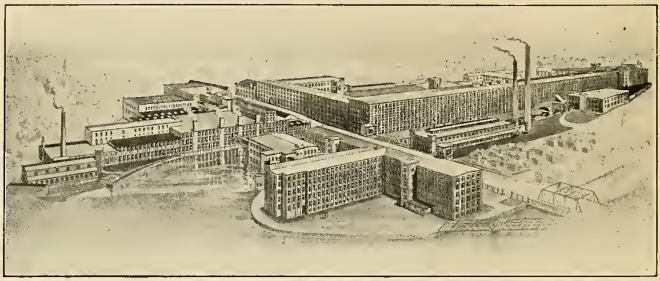
PACIFIC MILLS

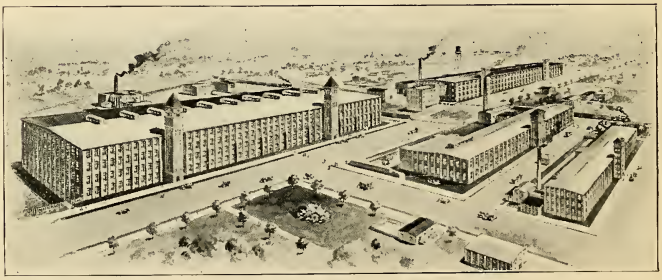
INCORPORATED IN 1853.



COTTON DEPARTMENT
PACIFIC MILLS
LAWRENCE, MASS.
152,992 spindles and 3,833 looms making cotton cloths for printing and dyeing

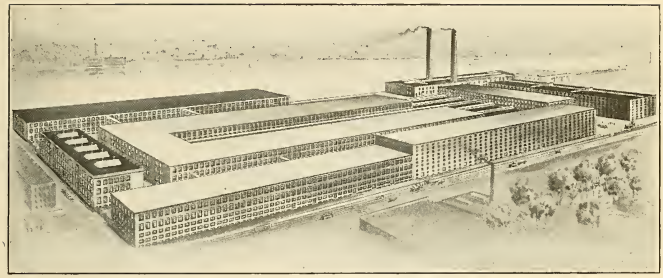


COCHECO DEPARTMENT
PACIFIC MILLS
DOVER, N. H.
148,128 spindles and 3,612 looms making cotton cloths for printing and dyeing.



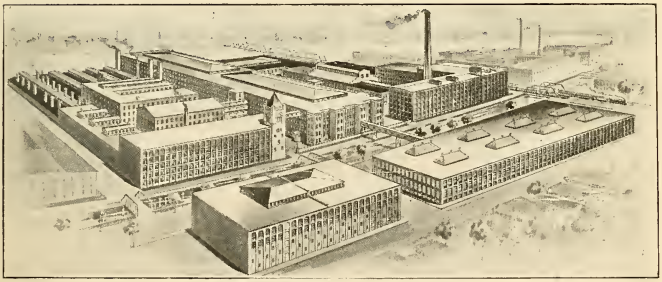
HAMPTON DEPARTMENT
PACIFIC MILLS
COLUMBIA, S. C.
198,736 spindles and 4,757 looms making cotton cloths for printing and dyeing.

179674



PRINT WORKS DEPARTMENT
PACIFIC MILLS
LAWRENCE, MASS.

Bleaching, dyeing, printing and finishing cotton cloths. 48 printing machines.



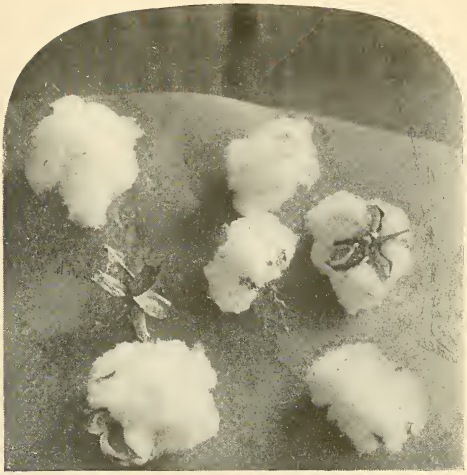
WORSTED DEPARTMENT
PACIFIC MILLS
LAWRENCE, MASS.

92,880 worsted spindles, 31,260 spindles for combed cotton yarns, and 3,435 looms making cotton-warp and all-wool dress goods.

T31+46
P2

Foreword

This pamphlet was compiled and printed at the office of the Pacific Mills, in Lawrence Massachusetts. It is intended to be used in connection with cabinets, made for school use, showing cotton and wool at each stage of manufacture from the raw material to the dyed, printed and finished cloth.



COTTON BOLLS

THE MANUFACTURE OF COTTON INTO CLOTH.

THE cotton fibre from which our common cloth is made, grows on a plant perhaps about two feet high mainly in our Southern States, along the Gulf coast, and as far north as the Mason and Dixon's line, where the soil and weather are best suited for it, but it

A COTTON FIELD IN SOUTH CAROLINA

also grows in other parts of the World as well.

The seeds are planted in the Springtime, and the little plant soon bears a yellowish flower; this blooms only a few days, and then a little pod grows in its place, full of seeds, and these seeds are wrapped up in downy fibres like fine hairs. In September or October, when the cotton is ripe, the pods, which are called "bolls" burst open and you see the fluffy white bunch of cotton which looks something like our common milkweed pod.

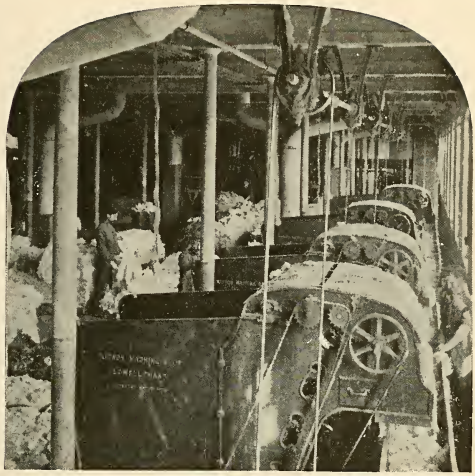
The cotton pickers now go through the fields with their great bags, and pick the cotton by hand. Then they take it to what is called the cotton "Gin," a machine which separates the cotton from the seeds around which it grows, and then it is pressed hard into great bundles called "bales," each of which will weigh about five hundred pounds, covered with bagging and held together by strong iron hoops.

When these bales of cotton reach the mill the cotton is in a close mass; the fibres

A BALE OF COTTON

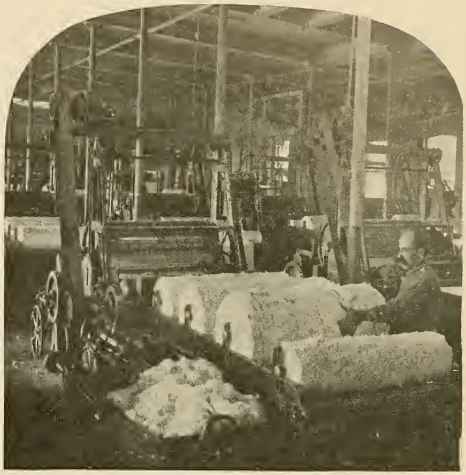
which are kinky, are crossed and recrossed, and wrapped around each other like a bunch of snarled hair. Besides this the cotton contains dirt, sand, seeds and pieces of leaves.

Now suppose we go into the cotton mill and see what is done to this dirty cotton before it can be made into nice, clean cloth, like your fresh, clean handkerchief. If we could follow one of these bales through the mill, the different rooms, and the machines it would have to pass through would be about like this:



BALE BREAKERS AND CARRYING BELT

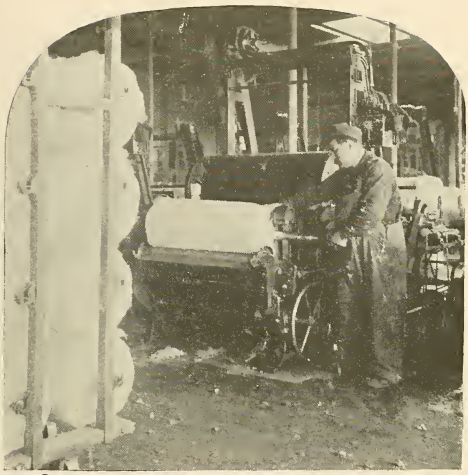
PICKING. The first thing to do is to take out all we can of this dirt, for we cannot make clean yarn or cloth from dirty cotton. A man gets a bale of cotton from the storehouse and wheels it on a truck to the "Picker" room. He cuts the hoops, takes off the bagging from the outside of the bale, and throws the cotton into a machine called a "Bale-breaker" which breaks up the mass of cotton into small bunches, and then it is carried by a long belt to the "Feeders". The machines have



INTERMEDIATE PICKER

wooden slats with pins in them which pick up the cotton and carry it into the Opener where it is torn or picked apart just as you would with your fingers, into little bits of pieces. Then it falls into a wooden trunk which slants upward and a draft of air from a fan sucks it up through this trunk along iron rods, and as it is all in little pieces the sand and heavy waste drops down into the bottom of the trunk.

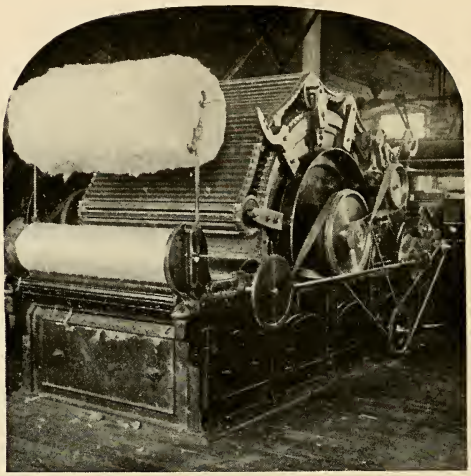
When it comes out at the other end of this trunk it drops into the next machine which



FINISHER PICKER

makes it into a sheet or "lap" and it is rolled up on a stick and is nearly as big as a barrel. Then four of these laps are put into another machine called the Intermediate, then four from that machine into the Finisher, and all these machines pick the cotton to pieces and beat out the dirt, and the lap from the last machine looks like what you know as "Cotton Batting."

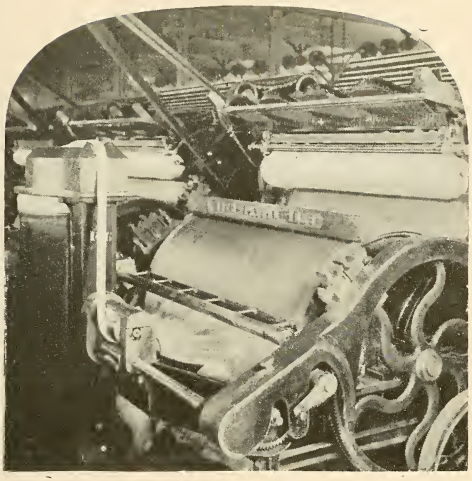
Now we think we have the heavy sand and dirt all taken out, but still there are some pieces of leaves which we must get rid of, and then the cot-



A COTTON CARD

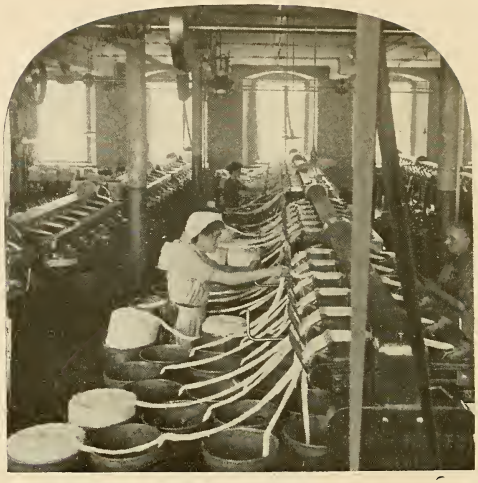
ton is still more or less matted together, and before we can make it into yarn the fibres must be straightened out and made to lie side by side; there are also short bits of fibres which we must take out if we want the yarn to be strong and even.

CARDING. Next we go to the Carding Room Here the lap is put into a machine called a "Card," which has two big drums which roll together but do not quite touch, The outside of these drums is



A COTTON CARD, DELIVERY END

covered with leather or cloth in which fine wires sharpened like needles are set close together, and the cotton is brushed between the two drums and straightened out much as when you brush your hair, and the wide lap, over a yard wide when it goes into the Card, comes out a fine clean light strand about like a big rope, and is coiled or wound around into a tall can about three feet high and a foot across the top. Next these cans are taken to the Drawing frames. There are three of these, one right after the



DRAWING FRAMES

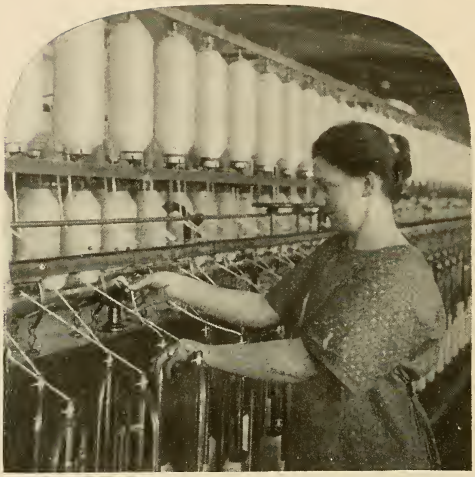
other, and each one takes 6 of these strands like cotton rope, and runs them in between little rolls and they come out only one strand about as large as each one of the 6 it was made from. The cotton is now as clean as we can get it, and the little cotton fibres have been straightened out and we are all ready to make this cotton rope smaller and smaller until it is fine yarn like thread.

SLUBBERS

ROVING.

Slubber
Intermediate
Fly Frame

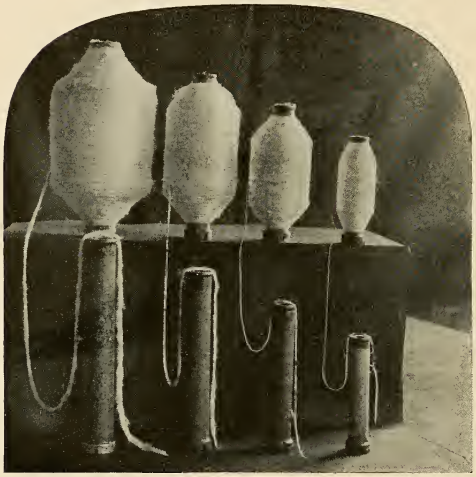
There are three kinds of Roving frames in this room, each of these has spindles carrying wooden bobbins like spools without heads, which turn very rapidly. Each machine takes two strands made on the machine just before it, and makes them into one strand a little smaller, so that what was once like rope, becomes like clothes-line, then smaller and smaller until it leaves the Fly frame



INTERMEDIATE ROVING FRAMES

about as large as the string which your grocer ties his bundles with. Instead of calling it rope or string the girls in the mill call it "Roving" and it is wound up on bobbins as they whirl about, and looks very white and clean.

FINE ROVING FRAMES



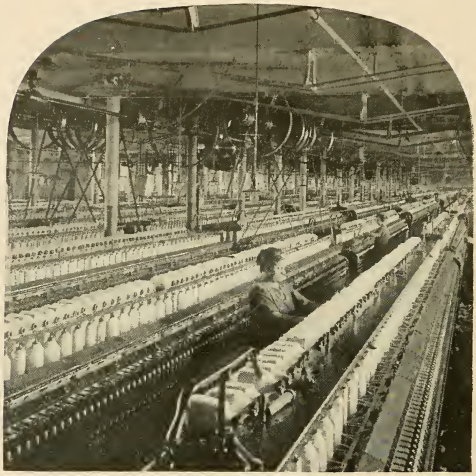
COTTON ROVING, FOUR PROCESSES

COTTON SPINNING "DOFFER" GIRL

SPINNING

Spinning
Twisting

Now the roving is fine enough to spin into yarn. The bobbins holding the roving are hollow, and a stick is run through each one and it is set up straight in a rack on top of the spinning frame. This frame has a large number of spindles set in a straight row and close together along the sides of the machine, and on each spindle is a small bobbin on which the yarn is wound say about six inches long and half an inch thick. A strand of the



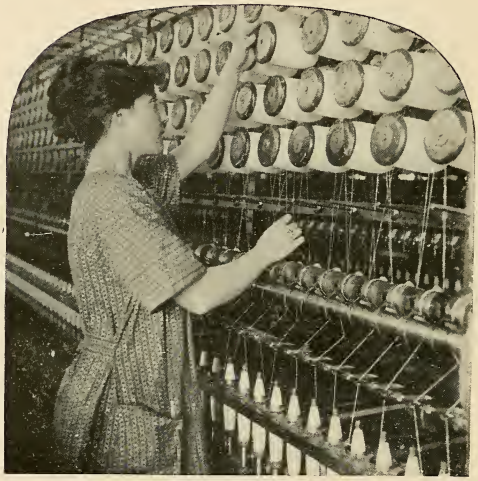
A COTTON SPINNING ROOM

roving from the bobbin on top of the frame is fed through a little trumpet, then it goes between iron rolls covered with leather which run at different speeds, and they pull the strand out and make it smaller, then it goes through a little rounded piece of steel called a "Traveler" which runs so fast you cannot see it, on a ring about two inches across, and the spindle "spins" like a top in the middle of this ring.

There are two kinds of yarn, the warp threads which run the long way of the cloth, and the

A COTTON SPINNER

filling threads which run across from side to side The filling yarn is spun on its kind of bobbins and then it is all ready to go directly to the shuttle which unwinds it in the loom when we are ready to make the yarn into cloth, but the warp yarn has to go to some other rooms, and through two or three other machines before we can use this to make into cloth. Sometimes also we want very strong yarn, so then we twist two or three threads of yarn together, but of course this makes rather coarse yarn and heavy cloth.



COTTON TWISTING

COTTON SPINNERS EXAMINING YARN

COTTON YARN ON FILLING BOBBIN, WARP BOBBIN, SPOOL

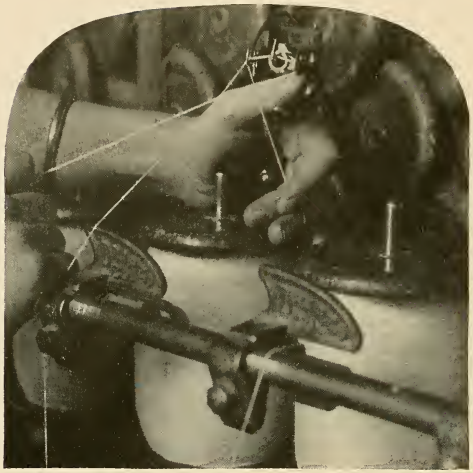
SPOOLING.

When the warp yarn is put into the loom it is on a roll, and as we sometimes have to make several thousand yards of cloth from one roll you will see that we have to use very long threads, and then there are a good many threads in a wide piece of cloth, so we have to put the threads from a good many bobbins onto this roll. When the bobbins on the spinning frame are full, they are "doffed" by

COTTON SPOOLING

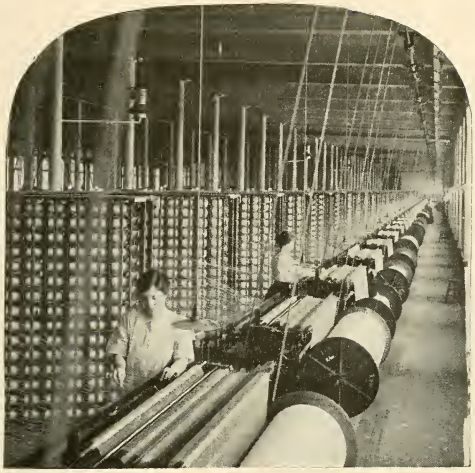
girls or boys who lift the bobbins off the spindles and put on empty bobbins in their place.

These full warp bobbins are now taken to the Spooler. Each is put into a little holder so it can easily be unwound, and the end of the thread is tied to another thread on a large spool having two heads, which holds about a mile of yarn when it is full. For tieing these ends together quickly the girl has a funny little machine which she wears on her left hand; she takes the two threads, places them across a little hook,



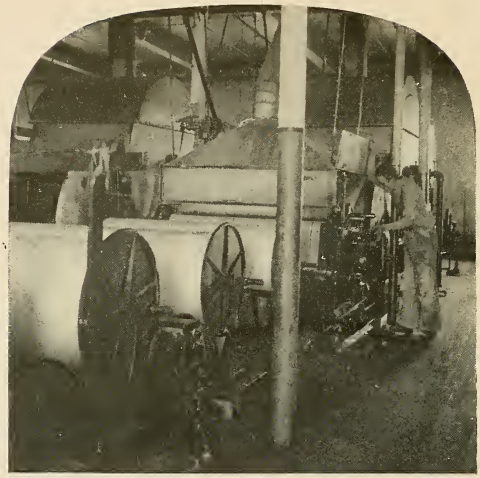
TIEING YARN WITH "KNOT TYER"

shuts her hand, and the machine ties a knot and cuts off the loose ends close to the knot much quicker and neater than you would be apt to do it if in a hurry. The large spools turn on spindles and it takes quite a number of bobbins to fill a spool.



COTTON WARPERS

WARPING When the spools are full they are taken to the Warper creel, which is a rack in which say 300 to 400 spools are set in glass rests so that a thread from each spool can be wound off onto a large Warper beam, which is a wooden roll with iron heads and holds say 25,000 to 30,000 yards in length of these 300 or 400 warp threads. We should have told you that on this machine, and on many of the others all over the mill, the threads run through loops or guides in such a



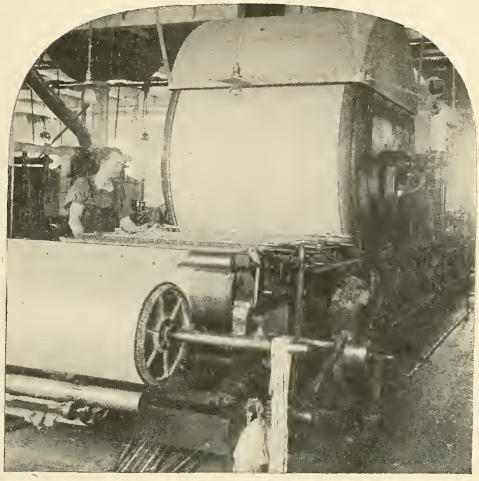
COTTON SLASHING, ENTERING END

way that if a thread breaks it stops the machine and so prevents uneven places and waste.

Of course when these spools "run out" or are emptied, the girl has to tie the end onto a new full spool, and this keeps her busy most of the time.

SLASHING

If a cloth is 40 inches wide and there are 50 threads to the inch, it means that there will be about 2000 threads in the roll or "beam" as it is put into the loom. To get these 2000 threads onto

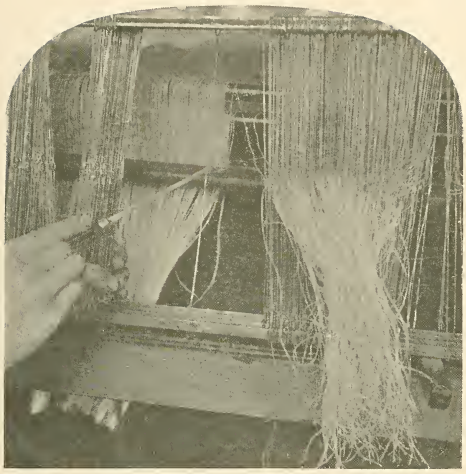


COTTON SLASHER, DELIVERY END

one beam we take say 5 of the Warper beams of 400 threads each and run them through the Slasher. This machine has a rack for holding the Warper beams, a wooden box which is filled with hot starch, and two large copper drums filled with steam and very hot. The yarn from the beams is unwound and drawn through the hot starch, then over the outside of the hot drums which dry it : then it is tightly wound onto the roll or what we call the "loom beam". The

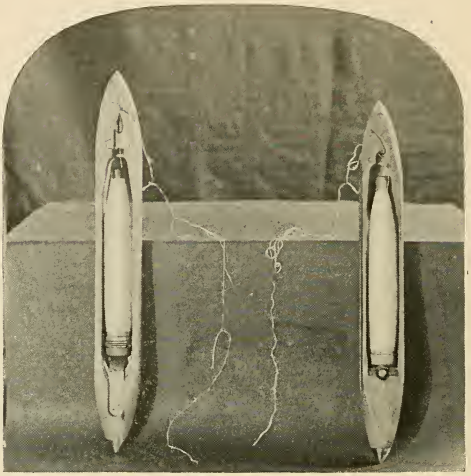
WEB DRAWING

starch on the threads has several uses ; the thread is apt to be soft and to curl up and get easily tangled, and the starch makes it stiffer and more easily handled when we draw the threads into the eye of the harness, which we are soon going to tell you about, and also makes it stand the rubbing of the shuttle and the harness when we weave it into cloth, with less danger of getting broken.



WEB DRAWING

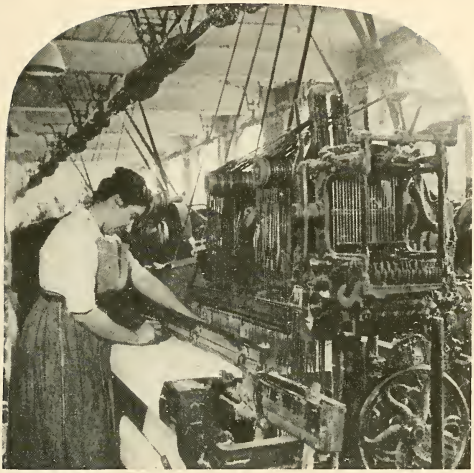
WEB-DRAWING. Next the beam is "drawn-in" when a girl with a little hook pulls the threads one at a time through the eye of a "harness" which is made of twine cords, or wire, say 10 inches long, having an "eye" in the middle and fastened at each end to wooden rods which lift and drop in the loom, carrying the warp threads with them, and are used in making the pattern in the cloth —if it is a "Plain" cloth there are but two harnesses, each carrying half the warp threads, but if it is a fancy weave, that is, has a figure in it, then it may take quite a lot of harnesses.



FILLING YARN IN LOOM SHUTTLES

WEAVING

Probably most of you have seen a loom, or have an idea what it looks like and how it works. To a child who has never seen a loom the weaving may be said to be much like mother darning socks, for just as her needle draws the yarn in and out between the threads which run the other way, so the shuttle in the loom carries the filling thread over and under among the warp threads and makes the firm cloth.



FANCY LOOM WITH DOBBY HEAD

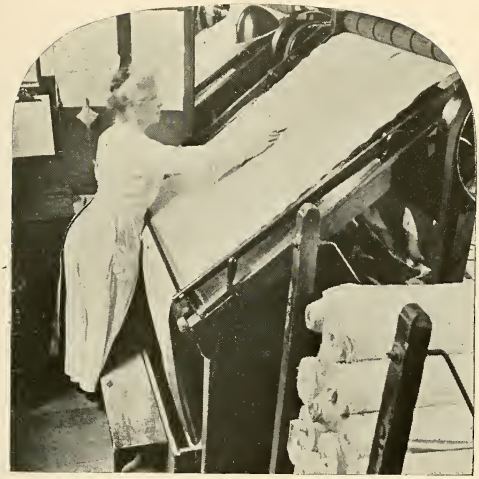
The loom beam, with the threads drawn in to the harness, and also through a "reed" (which is like a large comb and keeps the threads separate) is set into the loom; the harnesses rise and fall and thus open up the warp threads so that the shuttle can pass through, carrying the filling thread, and the way the threads cross each other makes the pattern or figure.

There are two kinds of cloth, plain and fancy or figured. Your mother's apron very likely

COTTON WEAVING ROOM, PLAIN AUTOMATIC LOOMS

is plain cloth, while your table-cloth is probably figured. In the plain cloth half the warp threads are held up and half dropped down, the filling thread is carried through by the shuttle, then before it comes back the harnesses take turns and the filling thread is thus shut in between the warp threads which are half the time above and half the time below the filling thread.

If the cloth is woven with yarn just as it comes from the spindle without being dyed it is



INSPECTING GRAY CLOTH FOR IMPERFECTIONS

known as "grey" cloth, or when you buy it at the store it would be called "unbleached". "White" cloth would be bleached, and then there are a great number of kinds of dyed and printed cloths just as there are a great number of fancy kinds of weaving.

The PACIFIC MILLS is one of the largest cloth making companies in the United States. For about 65 years this company has been among the leaders in making both cotton and worsted dress goods for ladies' wear. Over 15,000 looms are busy all the time making the millions of yards of cloth turned out each year, and all the cotton cloth is dyed or printed in its great Pacific Print Works at Lawrence, Massachusetts, whose name is known in nearly every home all over our Country.

CALICO PRINTING AND DYEING

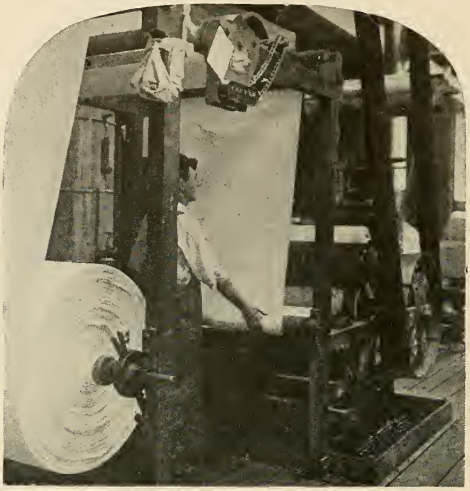
CALICO PRINTING

Cotton Cloth as it comes from the loom is known as "gray" or unbleached cloth. It is rather yellowish in color and does not have a finished appearance, so if you want a nice white cloth it must be bleached. Perhaps your mother prefers to buy the unbleached cloth and bleach it herself, which she can do by spreading it on the grass and letting the sun shine on it for a few days, but usually she buys it already bleached. But if she wants to make it into aprons or house dresses, drapery curtain, or for any other purpose where she wants it colored, then it must be dyed or printed.

INDIGO DYEING MACHINE

DYEING

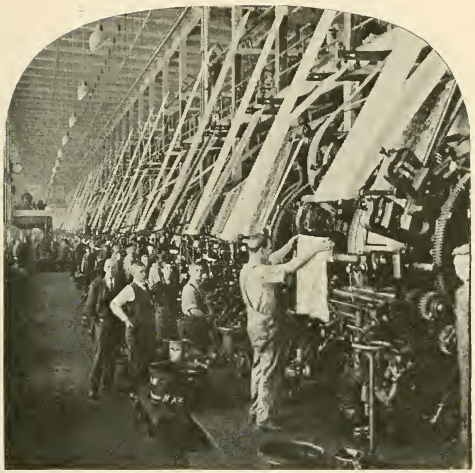
When cloth is dyed in large factories the ends of a good many pieces are sewed together so as to make a long roll of many yards and this cloth is drawn by rollers through large boxes filled with the liquid dyes, after which it is dried, starched and ironed (calendered) and wrapped up into neat packages.



PADDER FOR DYEING

PRINTING

By printing is meant the stamping of a colored figure or pattern on the cloth. Many years ago the Chinese and the Egyptians printed figures on cloth by means of wooden blocks on which the figure was cut, then color was spread over the face of the block which was then placed on the cloth and a sharp blow from a mallet stamped the figure on the cloth. This was rather slow work, you see it would take a



A LINE OF 48 CALICO PRINTING MACHINES

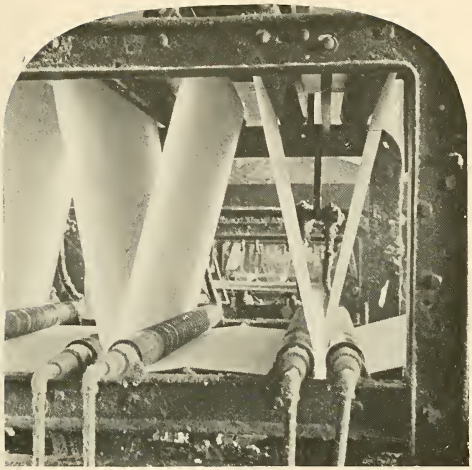
long time to stamp figures over many yards of cloth, and it would cost too much. Now, instead of wooden blocks we use copper rollers, one for each color in the pattern, each roller having engraved or "sunk in" on its smooth face that part of the pattern which goes with its color. These rollers are placed in the printing machine so as to turn or roll against the face of a large drum about as wide as the rolls are long, the cloth is drawn between the drum and the rolls, and each roll in turn prints on its color so that what

SEWING ENDS OF GRAY CLOTH PIECES BEFORE SINGEING.

went in as clean white cloth comes away from the last roll with all the colors exactly fitting each other, and a good many yards a day can be printed on one of these machines.

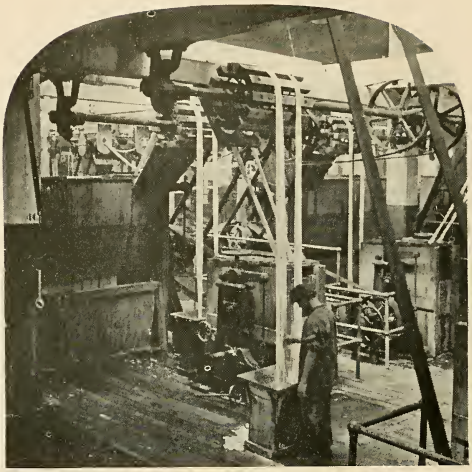
Preparation for Printing

But you must not think that printing is a simple matter—there are a good many things that have to be done to the cloth before it is ready to be printed upon, and it has to be handled a good many times after-



SINGEING CLOTH BY GAS FLAMES

ward before it has that nice "finish" which would lead your mother to buy it as a good piece of cloth. You know how easy it is to write with a good pen on a piece of smooth paper, but on a coarse rough paper, or when you get a bit of lint in your pen, then the ink spreads and you get an ugly blotch, Just so when we wish to print a pattern on the cloth, it must first be made white and with a smooth surface. When the cloth comes from the loom there is a loose fuzz on the face which would act just like the

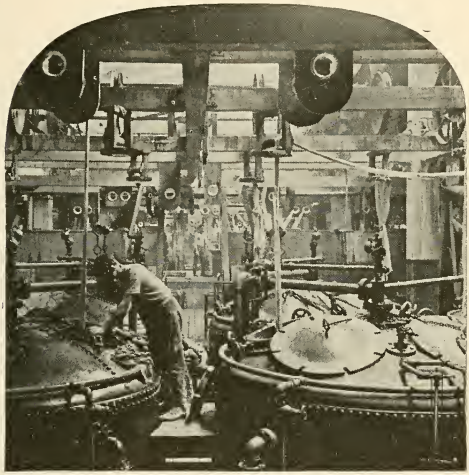


BLEACHING

lint in your pen, and there are also ends of threads and knots, and the first thing we do is to get rid of these.

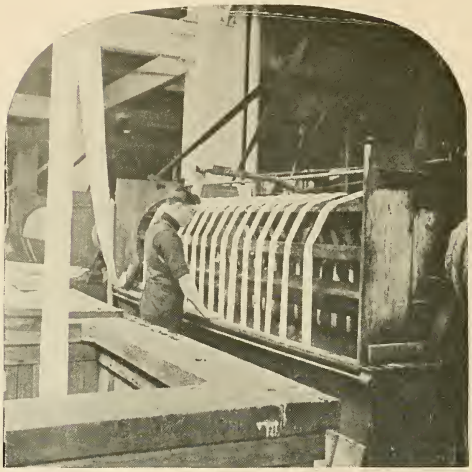
SHEARING and SINGEING

First, as we wish to handle the cloth in long rolls, we sew the ends of a number of pieces together. Then this cloth is fed through what is called a Cotton Shear so that the face of the cloth just grazes the edge of fast turning shear blades much like the cutter in a lawn-



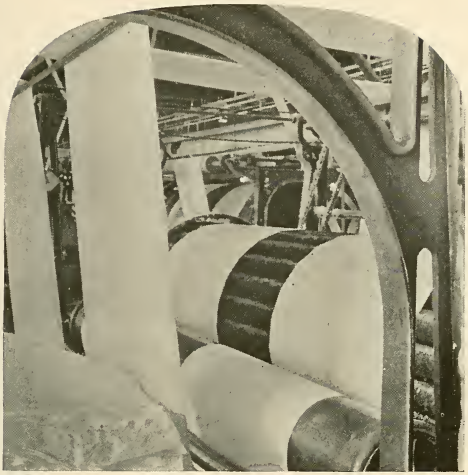
BLEACHING KIERS

mower, and these shear blades cut off loose threads and knots and trim the edges of the cloth. But in removing the lint we have to use a much more delicate way so as not to injure the cloth, so we run the cloth through a gas flame just quick enough to burn off the fuzz and not burn the cloth itself.



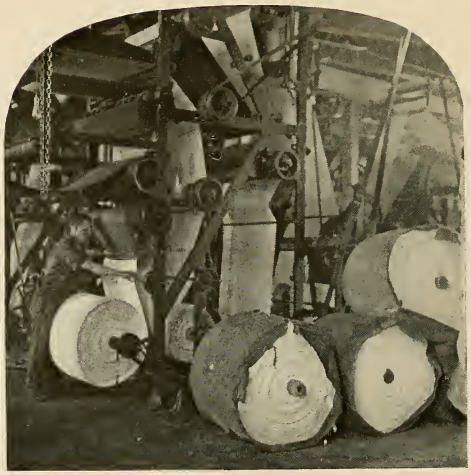
WASHING CLOTH AFTER BLEACHING

BLEACHING Now unless the cloth is to be finished as a flannel (in which case it goes through a machine called a Napper which raises a "Nap" on the cloth by means of rolls covered with fine wire points which scratch up the cotton fibres much as when you stroke a cat's fur the wrong way) the singed cloth is fed into large iron tanks called Bleaching Kiers where it is boiled for about twelve hours in a solution of



NAPPING

caustic soda, then washed and soaked for several hours in bins containing dilute acid which takes out iron stains, etc. Then again washed and a second time is boiled twelve hours in kiers, after which it is washed and run through a solution of Bleaching powder, and then allowed to steep for several hours in pits provided for this purpose. This treatment removes all impurities, turns the cloth from a dirty yellow to a pure white and also makes the cotton more



WHITE CLOTH IN ROLLS READY TO FEED INTO PRINTING MACHINE

receptive to the color with which it is to be dyed or printed.

Once more it is washed and then drawn over the surface of copper cans filled with hot steam to dry it, then it is wound into large rolls about the size of a big bass drum, as shown in the picture above.

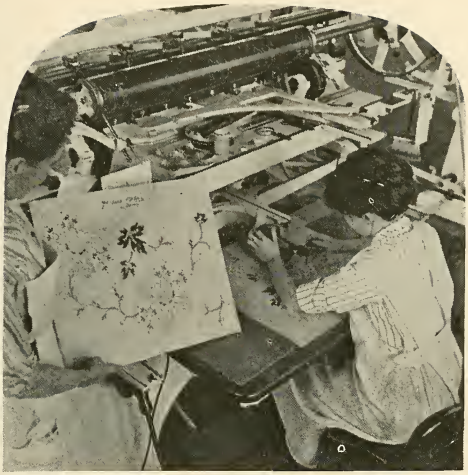
MIXING COLORS FOR PRINTING ON CLOTH

COLOR MIXING. Meantime in an adjoining department the colors are being prepared for the printing of the patterns on the white cloth. Gums from Africa and Asia, starches made from our own American corn or wheat, dyestuffs of many kinds from all over the world are mixed in great tanks or boiled in copper kettles and are about as thick as mucilage when spread on the copper rollers and by them transferred to the cloth.

CUTTING ENLARGED DESIGN ON ZINC PLATE

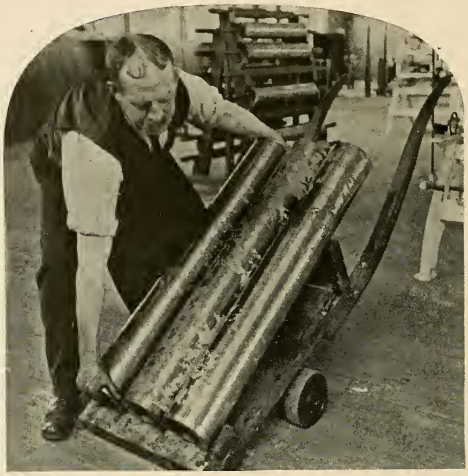
ENGRAVING

As we told you before, the pattern is printed on the cloth by the use of engraved copper rollers, and this is a very interesting part of the work. The designer makes up out of his head what he thinks will be a pleasing design to print on a certain style of cloth, and paints it carefully in colors on a sheet of white paper, making the figure the size it is to be when printed. This design is given to a man called a sketch-maker who places



TRANSFERRING DESIGN FROM ZINC PLATE TO COPPER ROLLER

it in a large camera which magnifies it until it is say twenty or twenty-five times as large as at first then he carefully corrects the lines so that the design is made perfect, and draws it in pencil on a large sheet of zinc; next this goes to another man who with a sharp tool called a graver cuts along these pencil lines and makes a groove in the zinc. Then this zinc plate is painted so that each color of the pattern is distinctly marked, and is then placed in a machine called a pantograph and a girl traces with a little pointer like

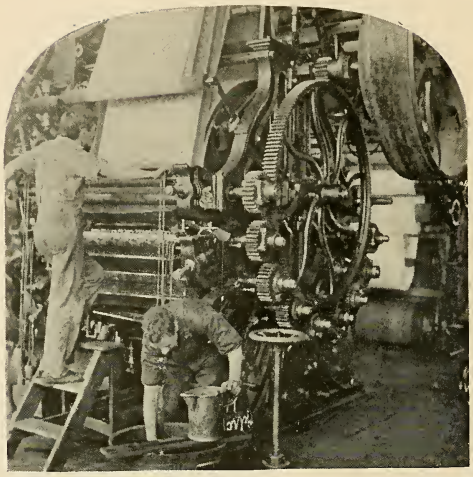


COPPER ROLLS AFTER DESIGN HAS BEEN ETCHED ON SURFACE

a lead pencil along the grooved lines belonging to one of the colors. In this machine has been placed a copper roller which has been coated with varnish, and there are rows of little diamond points which are set so as to almost touch the roller, and as the girl traces the lines with the little pointer she presses a treadle with her foot and this pushes the diamond points against the roller and they cut through the varnish and draw the pattern brought back to the size it was first drawn by the designer, and repeat this

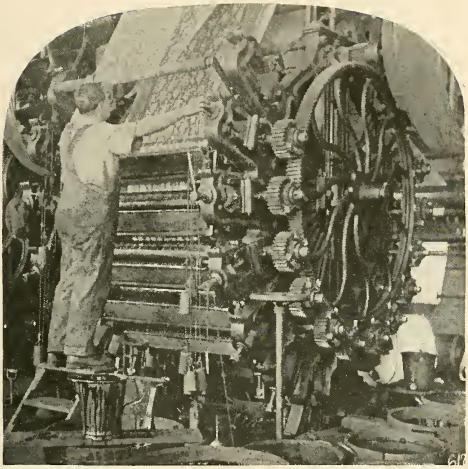
DESIGN ON ZINC PLATE

figure all the way across the face of the roller as many times as the width of the cloth will allow, if it is a small figure it would be repeated quite a number of times. After she has traced that part of the pattern which belongs to one color, another roller is put into the machine and on that is marked its color, and so on until the whole set of rollers for that design has been prepared. These rollers are next put into an etching trough filled with nitric acid which eats into the copper where the varnish has been cut away by the diamond points, leaving a little groove sunken in the surface of the copper.



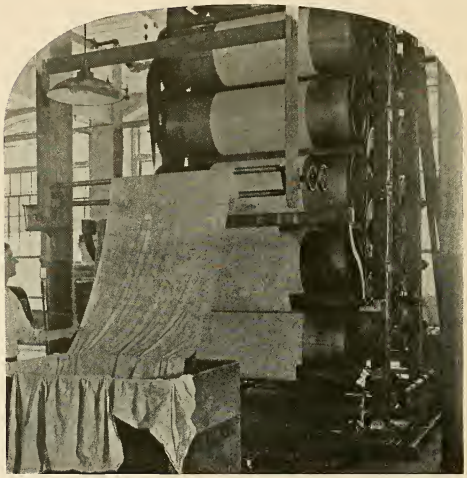
A PRINTING MACHINE

PRINTING. The copper rollers, each with a part of the pattern sunk in its surface, are now placed in the printing machine which we have told you about before, and each rests in a pan in which the color to be printed on the cloth has been put. A revolving brush spreads the color on the roller, but there is a sharp knife edge which is fixed lengthwise across the face of the roller and this scrapes off the color so that it remains only in the little groove etched for its part of the pattern,



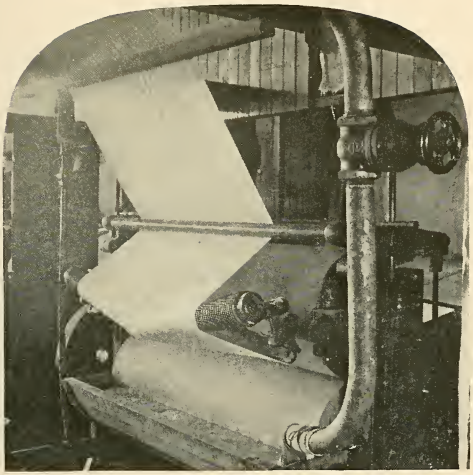
MACHINE PRINTING TWELVE COLORS

and as it comes in contact with the cloth the color is transfered to it in its proper place. These rollers have to be very carefully placed in the machine so that each will print in exactly the right place, otherwise one color would over-lap another and spoil the pattern. The white cloth is put into the printing machine in a big roll, and is wound over the surface of the drum of the machine, and as it goes round, each roller puts on its color and the cloth comes off completely printed by going through the machine only once.



VERTICAL DRYING MACHINE

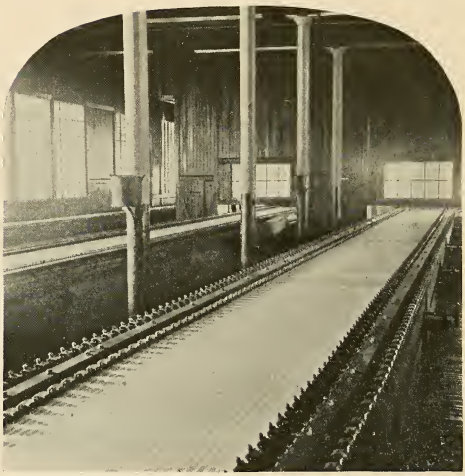
The patterns are not printed in just the same colors all the time, today the cloth may have more blue, to-morrow more red, the pattern is printed in all sorts of combinations of colors, but always they must blend and make a pleasing appearance, for no one would buy a piece of cloth that did not look pretty.



CLOTH BEING FED INTO STARCH END OF TENTER

STEAMING. Just as you cannot handle paper on which you have written until the ink is dry, so this cloth cannot be handled when first printed but must be drawn over a number of large "dry cans" which are copper cans or drums filled with hot steam, which turn slowly and soon dry it.

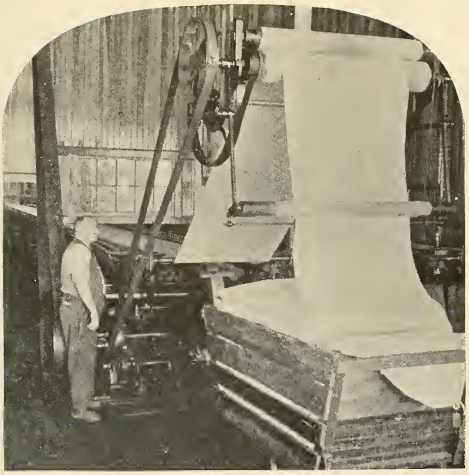
Next the cloth is put into iron boxes where it is thoroughly filled with hot steam which is done to make the colors "fast," or so that they will not fade or grow dull.



CLOTH BEING STRETCHED IN TENTER

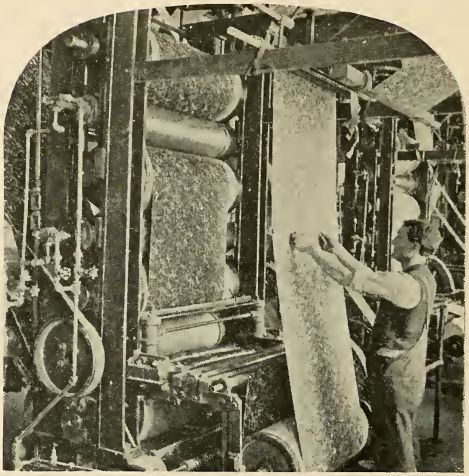
WASHING
DRYING
STARCHING
TENTERING

After this the cloth is well washed, then dried over more dry cans. Now that the cloth is all printed we come to the "Finishing." This clean cloth is next drawn through boxes filled with hot starch and goes immediately into the Tenter frames. These are about a hundred feet long and three to four feet wide and consist of long lines of hot steam pipes. On each side of the



TENTER—DELIVERY END

frame is an endless chain having "clips" which grip hold of the edges of the cloth as it is fed into them, and as the cloth slowly goes the whole length of the frame it is thoroughly dried and the tension on the chain brings the cloth out all exactly the same width.



CALENDERING OR "IRONING"

Calendering

Our printed or dyed cloth has now been washed, starched and dried; next we must iron it. Think what a task it would be to iron by hand as your laundress does, all the four or five million yards of cloth which a large Print Works handles each week. Instead of a hand iron we use great polished steel rolls set in a frame, and their weight brings a great pressure upon the cloth as it runs between the rolls, and this gives it a final finish.

FOLDING FINISHED CLOTH INTO PIECES OF ABOUT 40 YARDS.

FOLDING. You will recall that the first thing we did in getting the gray cloth ready to print was to sew many pieces together to make a long roll. Now that the cloth is all finished we need to get it back again into pieces of a size such as you see on the shelves of a drygoods store. A roll of finished cloth is put into a folding machine which unwinds it and folds it into layers a yard long, and each forty yards or so it is cut off and then this "piece" is folded by hand into con-

DOUBLING AND WINDING

venient shape. Sometimes it is doubled and wound into pieces half the width of the cloth, and this makes a very compact bundle. Paper bands are strapped around each end of the piece and a "ticket" is pasted on it which shows its trade name, and tells the number of yards contained in the piece. A trade name sometimes becomes quite valuable, a cloth gains a reputation for fine quality and in time its name becomes a household word.

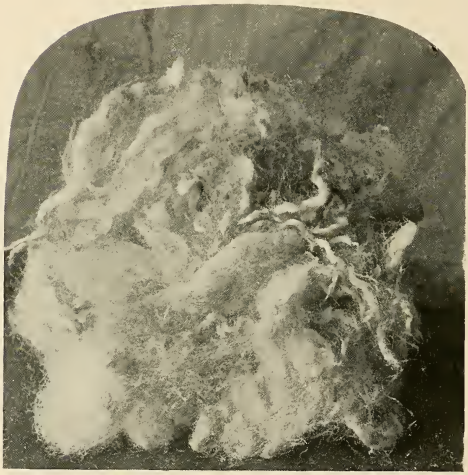
PUTTING PAPER BANDS AND TICKETS ON FINISHED CLOTH

PACKING. To have the cloth reach you fresh and clean and unwrinkled it is wrapped up in paper and carefully packed in a wooden case which has been lined with paper. Each case is made to order and of just the right size to hold the pieces of cloth to be packed in it. Sometimes where cloth is shipped to foreign countries it must be packed in waterproof cloth, or wrapped in bales of a size that can be carried on the

PACKING CLOTH IN CASES FOR SHIPMENT.

backs of mules or camels, for it is not everywhere the railroads or ships can transport goods, but wherever civilized human beings live they must have clothes, and a large part of the human race wears cotton.

THE MANUFACTURE OF WOOL INTO CLOTH.



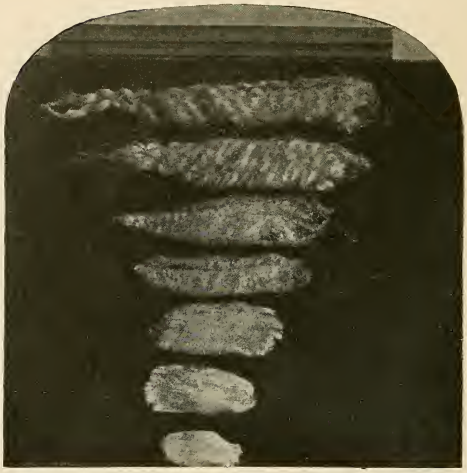
RAW WOOL

A FLEECE FROM ONE SHEEP.

THE MANUFACTURE OF WOOL INTO CLOTH.

All of us are familiar with pictures of Sheep grazing in green pastures, and have noticed how their bodies are nicely covered with a soft natural growth of hairy fibres. These hairy fibres are what is called "Wool".

This covering of a sheep's body, called a



VARIATIONS IN WOOL FIBRE.

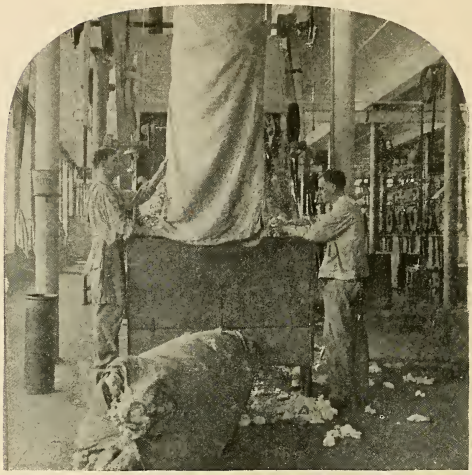
"Fleece" is carefully sheared or cut off about once each year, and supplies the mills with the wool or the raw material from which to make yarns and attractive cloths, both "Woolens" and "Worsteds". The fibres of the fleece, as clipped from the sheep's body, vary greatly; coarse, fine, strong and tender locks all being present in the Wool in its natural condition, and until sorted are unfit for making into yarns and cloth.

SORTING WOOL FOR QUALITY AND LENGTH OF FIBRE

SORTING

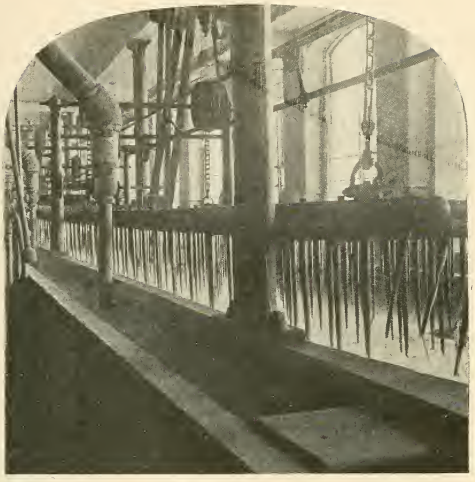
The first process in worsted manufacturing is that of sorting or classifying the fibres according to their length, fineness and soundness. The choicest wools grow on the shoulders and sides, and the poorest are to be found around the head, throat and chest.

Worsted yarns and cloths are made from long-fibred wools.



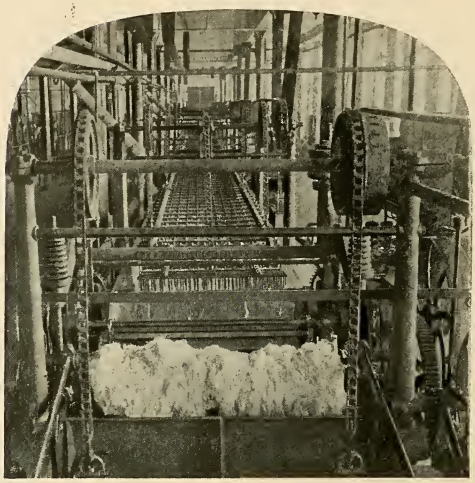
FEEDING SORTED WOOL INTO WOOL WASHER

SCOURING. In its natural or unwashed condition, wool contains a greasy substance known as yolk, which is a compound of potash and animal fat. A large amount of earthy matter also clings to the fleece, and there is so much of these foreign substances present in some wools that in the cleansing process they sometimes lose as much as two-thirds of their original weight. All this foreign material must be removed from the wool before we can spin it into good yarn.



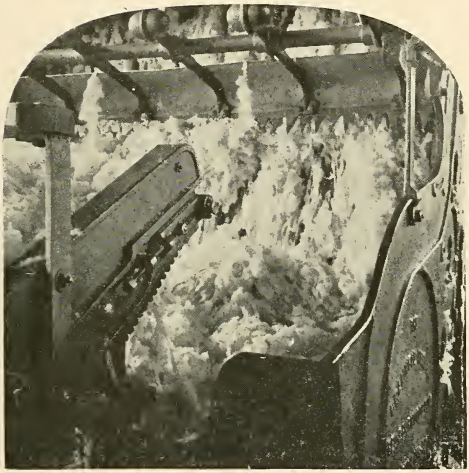
WOOL WASHER SHOWING RAKES FOR MOVING WOOL

A modern wool-scouring machine consists of four iron bowls or tanks, about 4 feet wide, and each ranging in length from twenty to forty feet. Three of these bowls are filled with a solution of warm water and soap, the fourth bowl contains warm water only. Through the length of these bowls the wool is gently pushed forward mechanically by rakes, and after passing through squeeze rollers is delivered onto the wire apron of a drying machine, and comes out at the opposite end in a clean and dry condition. Hot air is used in the drying machines for drying the wool.

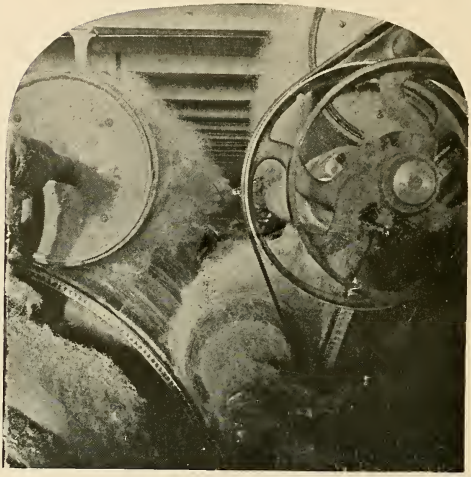


WOOL WASHER

In order to thoroughly dissolve and remove the foreign substances in the raw wool we have to use strong soaps made up largely with potash or soda, and this strong soap dissolves also much of the natural oil in the wool, so when the clean wool comes out of the drying machine we add olive oil to lubricate it and make it work more easily.



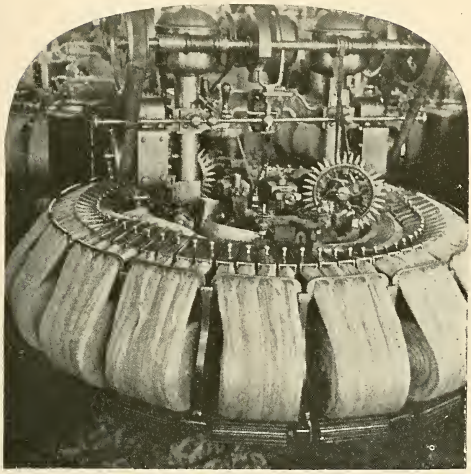
CLEAN WOOL FROM SCOURING



WOOL ON CARD CYLINDER

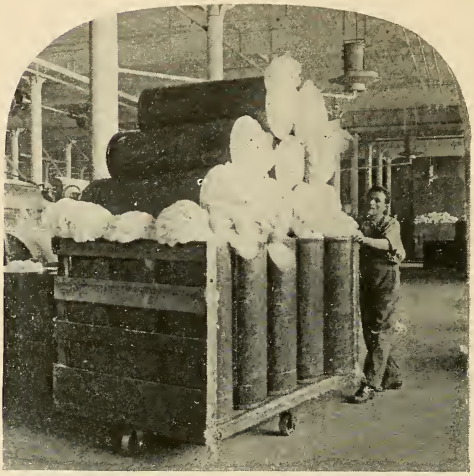
CARDING

The scoured wool is next taken to a Carding machine to have the felted locks not simply opened and unsnarled but actually divided into their component parts, the fibres being in fact separated from each other. This machine consists of a number of cylinders of various sizes, turning in opposite directions and at different speeds. These are all covered with fine, limber wire teeth called "card clothing" and the wool



WOOL COMBER

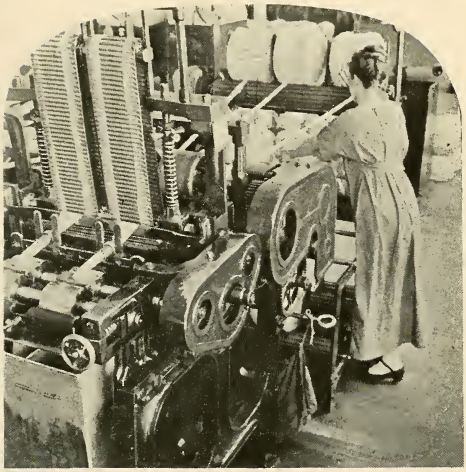
as it is brushed between these cylinders is all loosened up by the struggle which takes place between the contending wire surfaces, each trying to retain its hold on the wool fibres. The wool as it is delivered from the Card is in the form of a "sliver" or rope-like strand about the thickness of a man's wrist, and several of these slivers are pressed together into the form of a large ball, and placed on the creel of the Combing machine, which is the next process.



COMBED WOOL

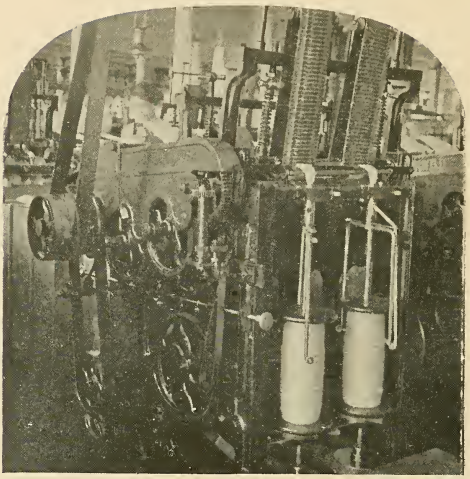
COMBING

There are two objects in view in combing the wool, first to straighten out the fibres and lay them side by side; and, second, to take out the short curly fibres present in the wool. This is done by stretching the wool between the pins of two adjoining circles, (one large and one small) at the point where they touch, and as the distance between them grows larger, the fibres are gradually drawn out between the teeth of the two sets of circles.



WOOL DRAWING—FIRST PROCESS

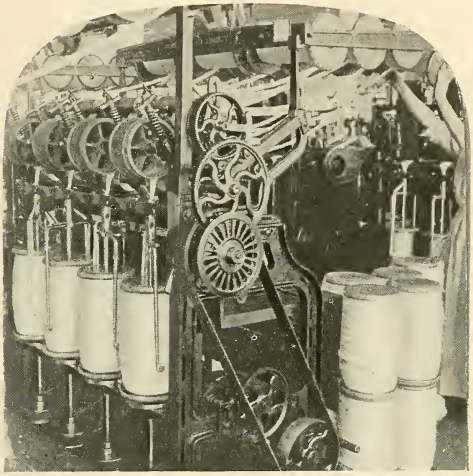
The fringe of long wool left hanging over the edge of the circles is drawn off by a pair of press rollers, and deposited in a can in the form of a sliver; this is afterwards wound into a ball which is called "Top". The short fibres remaining in the circles are taken out by steel blades and constitute what is called the "Noil."



TWO SPINDLE DRAWING FRAME

DRAWING

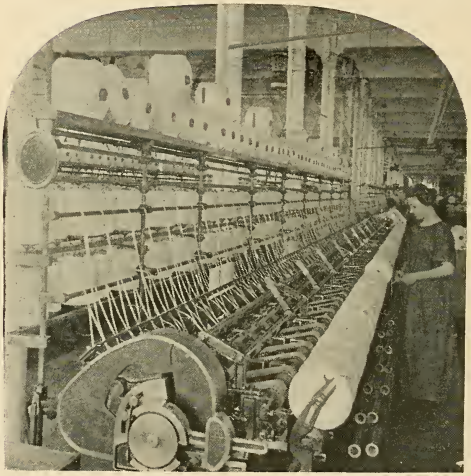
The Drawing process which follows the Combing, consists of six to nine operations, in each of which a number of slivers are placed side by side and then drawn out smaller. This is done by passing the strands of wool through two sets of rollers, the first running slowly and the second or delivery set turning quickly, and the faster it runs compared with the first set the more it "draws" the wool out and the smaller it becomes. For example, six slivers are united



FOUR SPINDLE DRAWING FRAME

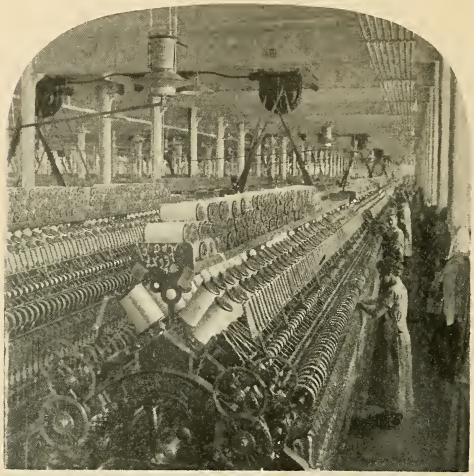
as one, and one yard of this combined sliver is stretched or drawn to eight yards in length, so that the new strand is only six-eights as thick as one of the individual slivers from which it is drawn.

This idea is carried out in every operation, until at the last machine the sliver is small enough to be suitable for placing in the creel of the spinning frame; in this state it is called "Roving."



FRENCH SYSTEM DRAWING FRAME

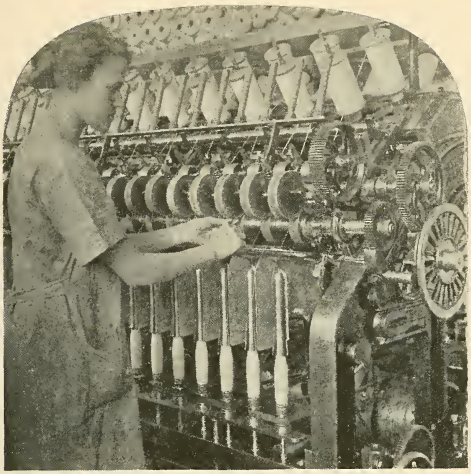
WORSTED ROVING FRAMES



WORSTED CAP SPINNING FRAMES

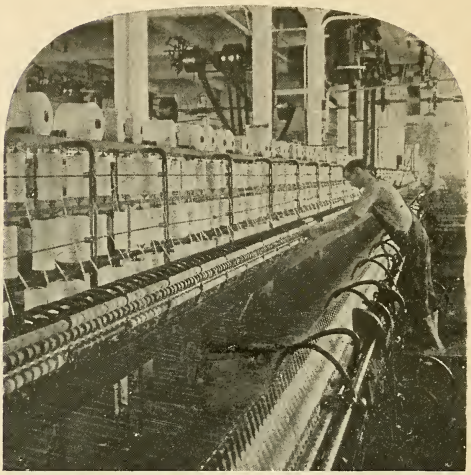
SPINNING

Up to this point of manufacture the sliver has little or no adhesiveness, or the quality which makes the fibres cling together. Roving has the form of a thick thread, but lacks strength, and easily breaks apart when strained or pulled. This weakness is due to the small amount of twist which has been put in, the fibers being simply laid side by side and given the slightest amount of twist, just enough to hold them together. On the spinning frame the roving is



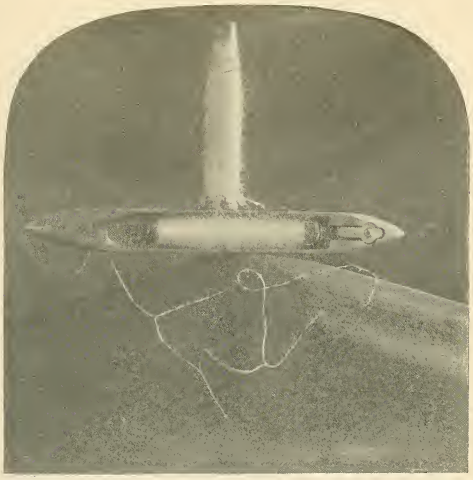
A "CAP" SPINNER

drawn down to the size of yarn wanted, and an amount of twist put into it which forces the separate fibres into such close contact with each other that the thread becomes strong, elastic and firm. There are two types of spinning frames, Cap and Mule. On the cap frame there is a row of spindles in fixed bearings on each side of a long frame, and the yarn is spun on a wooden bobbin turning on the spindle which has a metal cap on the top; the other and older type is called a Mule, and this is a long carriage holding



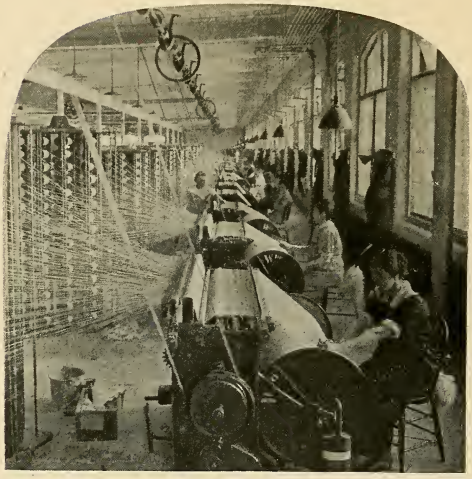
WORSTED "MULE" SPINNER

over a thousand spindles in a line, and the yarn is spun on paper tubes which fit snugly on the bare spindles. This carriage moves back and forth, first drawing out the yarn, and then reversing it winds it up on the spindles as it returns, and the spinner is kept very busy travelling back and forth on the watch for broken ends which he must at once piece up so as to spin as much yarn as possible each day. You have all seen pictures of an old-fashioned spinning wheel such as our great-grandmothers



WORSTED FILLING YARN ON BOBBIN AND IN LOOM SHUTTLE

used to spin the yarn from the wool grown on the backs of their own sheep. This had one spindle only, and a glance at the picture of a modern spinning mule clearly shows how much more yarn can be spun in a day by one operative than was made in the olden days of hand labor. Warp yarn has to be starched and wound onto loom beams, while the filling yarn, as spun on bobbins or tubes, is now ready to go into the shuttle.

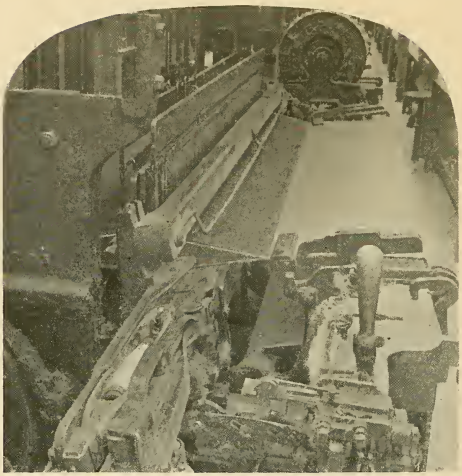


WARPING

WARPING The Warp yarn is spun on wooden bobbins on the "Cap" frames, or in the form of Cops on the paper tube on the bare spindles of the mule frames. Next it is wound off onto spools, and a thread from each of several hundred spools is wound onto a large beam as shown in the picture, which is called a Warper beam. Then the threads from several such beams, after being starched and dried on the Slasher, as

WEB DRAWING

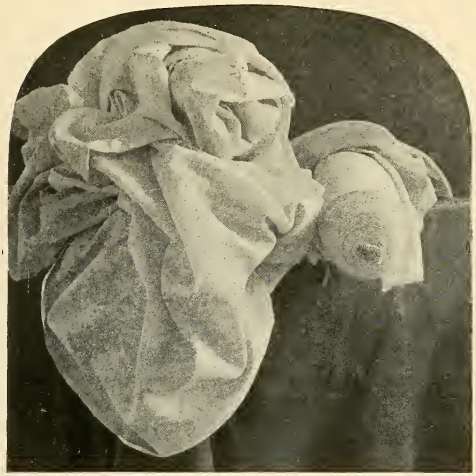
shown on pages 28 and 29 are wound on a smaller beam holding just the number of threads wanted in a given cloth, and taken to the Web Drawing room. Here each single thread is drawn through an eye in the centre of the harness or wire heddle, which controls its place in the making of the pattern in the woven cloth, then through a reed, which is like a long comb and it is all ready to go into the loom. See also picture on page 30.



BROAD WORSTED LOOM

WEAVING

Every kind of woven cloth, whether plain or figured, results from interlacing two distinct series of threads together. The threads which run lengthwise in the piece are called the warp or web; those which run across from side to side are called filling. The machine on which the interlacing is done is called a loom, and in it the warp threads are arranged in parallel order at equal distances apart. Each single thread is drawn through the eye of a



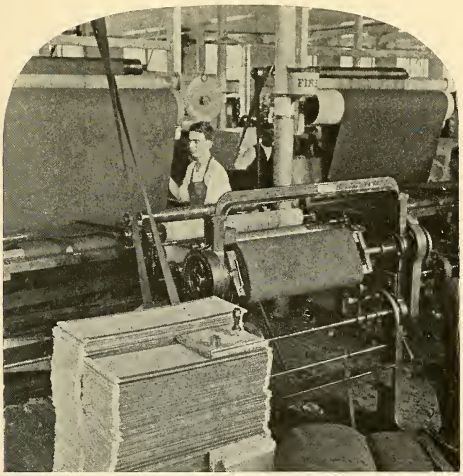
A PIECE OF WORSTED DRESS GOODS AS IT COMES FROM LOOM

harness. As the loom operates certain harness shafts are lifted up and at the same time others are pushed down, this leaves an opening between the two series of threads, and through this opening a shuttle is thrown carrying or unwinding behind it the filling thread, then the harnesses reverse, and the filling thread is caught and held between the warp threads, and the way the warp threads are arranged makes the pattern or figure in the woven cloth.

INSPECTING CLOTH

DYEING and FINISHING. Cloth taken from the loom is inspected, and any faulty places are mended. To make its surface smooth and clean the cloth is sheared by swiftly revolving knife-blade cutters and then singed over red-hot plates or through gas flames. To prepare it for dyeing it is boiled, steamed and scoured.

There are two main kinds of cloth dyeing, warp dyeing and piece dyeing. In the latter type the cloth is woven from yarns in their



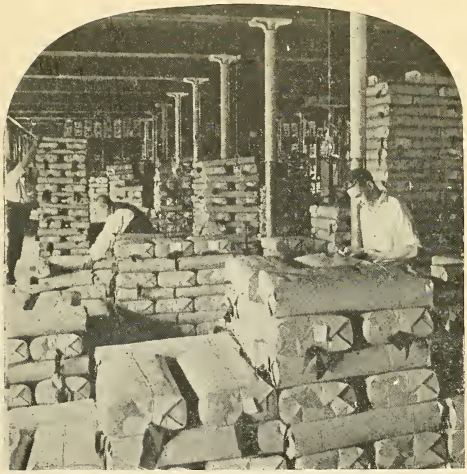
PRESSING AND WINDING FINISHED DRESS GOODS

natural color, and then the whole piece of cloth is drawn through the dye kettles and comes out a solid color, even throughout. See picture on page 39. In warp dyeing, the warp threads in the form of a rope are put through the dye, then the warp threads are put onto loom beams and the colors arranged as wanted.

A Navy-blue Serge may be thought of as piece dyed, while Ginghams or Scotch Plaids are warp dyed, or more properly yarn dyed.

BANDING AND TICKETING PIECES OF DRESS GOODS

After worsted cloth intended for ladies' dress goods has been dyed, the processes of finishing and preparing for the market are not far different from those described under the head of Cotton. The cloth goes through the Tenter frames where it is brought to its correct and uniform width, next pressed between hot plates or between a hot cylinder and bed, then doubled, measured and wound onto boards. Paper bands are strapped around each end of each piece, a ticket is attached to it showing its length and the



PACKING ROOM

trade name under which it is known, each piece wrapped in paper to keep it clean, and it is then all ready to be packed into wooden boxes and shipped to the drygoods store. The fleece of wool which grew on the back of a sheep in Montana, or it may be in Australia, has made its journey through the mill in Massachusetts and the cloth for your new dress is now in the store waiting for you to come and buy it.

The Pacific Mills have the largest print works in the world, with an unrivaled output of printed, dyed and bleached cotton goods, and are also the largest manufacturers of cotton-warp and all-wool dress goods.

INTERESTING FACTS—1918

The Pacific Mills have 177 acres of floor space.

10,300 operatives are employed: about 6,500 males and 3,800 females.

The weekly payróll paid in silver dollars piled one upon another would be more than twice the height of Washington Monument.

The annual payroll exceeds $7,500,000.

654,192 cotton and worsted spindles and 15,637 looms are in operation. If these looms were placed end to end, they would make a continuous line over 24 miles in length.

140,000 tons of high-grade soft coal are burned in the boilers annually.

The normal product of over 200,000 acres of cotton (or about 82,500 bales) and the wool from 2,366,400 sheep are woven every year.

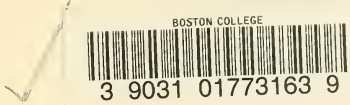
500 miles of cloth are finished and packed ready for shipment each day.

The annual output of finished cloths would reach more than five and one-half times around the world.

The pictures in this book are selected from photographs taken in our mills by J. MORTIMER COCHRANE of the KEYSTONE VIEW CO., Meadville, Pa. as part of their series of educational stereographic views for use in Schools, etc.

Date Due

MAY 8 '33 475



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